Principles of Engineering					
Principles Of Engineering (POE) is a high school-level survey course of engineering. The course exposes students to some of the major concepts that they will encounter in a postsecondary engineering course of study. Students have an opportunity to investigate engineering and high tech career POE gives students the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based (APPB) learning. Used in combination with a teaming approach, APPB learning challenges students to continually hone their interpersonal skills, creative abilities, and problem solving skills based upon engineering concepts. It also allows students to develop strategies to enable and direct their own learning, which is the ultimate goal of education.					
Program of Study to which the course applies	**Course Content**				
STEM-	100160				
	Course Content	**Reference Standards**	**Crosswalk to Common Core Standards**	**Crosswalk to Nebraska Standards**	**Comments**
Standard 1: Mechanisms	Students will demonstrate application of how mechanisms are used in the engineering design process.	PLTW-POE			
Benchmark 1.1	Apply math, science, and discipline-specific skills to solve problems.	PLTW-POE		MA.12.1.3.a MA.12.1.3.d MA.12.2.5.b MA.12.2.5.d MA.12.3.1.a SC 12.1.1.l	Discipline-specific skills might include a wide range of academic standards alignments not shown here, as applicable to particular tasks and activities.

Performance Indicator 1.1.1	Calculate mechanical advantage and drive ratios of mechanisms.	PLTW-POE			
Performance Indicator 1.1.2	Measure forces and distances related to mechanisms.	PLTW-POE			
Performance Indicator 1.1.3	Calculate work and power in mechanical systems.	PLTW-POE			
Benchmark 1.2	Describe how engineering and engineering technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 1.2.1	Identify and differentiate among different engineering disciplines.	PLTW-POE			
Benchmark 1.3	Understand that technical communication can be accomplished in oral, written, and visual forms and must be organized in a clear and concise manner.	PLTW-POE			
Performance Indicator 1.3.1	Conduct a professional interview and reflect on it in writing.	PLTW-POE			
Benchmark 1.4	Identify that most mechanisms are composed of gears, sprockets, pulley systems, and simple machines.	PLTW-POE	ELA.RST.11-12.4	LA.12.1.5	

Performance Indicator 1.4.1	Distinguish between the six simple machines, their attributes, and components.	PLTW-POE			
Performance Indicator 1.4.2	Design, create, and test gear, pulley, and sprocket systems.	PLTW-POE			
Benchmark 1.5	Illustrate how mechanisms are used to redirect energy within a system by manipulating force, speed, and distance.	PLTW-POE	MTH.N.VM.3	MA.12.2.5.b MA.12.3.2.a MA.12.3.2.b MA.12.3.2.d SC.12.1.1.b SC.12.1.1.l SC.12.2.2.c	Alignment presumes that students will design, test, and make predictions based on Newton's 2nd law of force when creating a gear, pulley, and sprocket system (NE: SC.12.1.1.b, SC.12.2.2.e).
Performance Indicator 1.5.1	Determine efficiency in a mechanical system.	PLTW-POE			
Performance Indicator 1.5.2	Design, create, test, and evaluate a compound machine design.	PLTW-POE			
Benchmark 1.6	Calculate the mechanical advantage ratios mathematically to evaluate input work versus output work of mechanisms.	PLTW-POE	MTH.A.CED.1	MA.12.2.4.b MA.12.2.5.b SC.12.1.1.b SC.12.1.1.l SC.12.2.2.c	
Performance Indicator 1.6.1	Design, create, and test gear, pulley, and sprocket systems.	PLTW-POE			
Performance Indicator 1.6.2	Calculate work and power in mechanical systems.	PLTW-POE			
Performance Indicator 1.6.3	Determine efficiency in a mechanical system.	PLTW-POE			

Standard 2: Energy Sources	Students will analyze energy sources through classifying, describing, and summarizing in various activities.				
Benchmark 2.1	Classify energy sources as nonrenewable, renewable, and inexhaustible.	PLTW-POE	ELA.RST.11-12.4	LA.12.1.5 SC.12.4.3.c	
Performance Indicator 2.1.1	Identify and categorize energy sources as nonrenewable, renewable, or inexhaustible	PLTW-POE			
Performance Indicator 2.1.2	Create and deliver a presentation to explain a specific energy source.	PLTW-POE			
Performance Indicator 2.1.3	Summarize and reflect upon information collected during a visit to a local utility company.	PLTW-POE			
Benchmark 2.2	Describe energy source processes including harnessing, storing, transporting, and converting.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a SC.12.2.3.b	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 2.2.1	Summarize and reflect upon information collected during a visit to a local utility company.	PLTW-POE			

Performance Indicator 2.2.2	Define the possible types of power conversion.	PLTW-POE			
Performance Indicator 2.2.3	Calculate work and power.	PLTW-POE			
Performance Indicator 2.2.4	Calculate power in a system that converts energy from electrical to mechanical.	PLTW-POE			
Performance Indicator 2.2.5	Determine efficiency of a system that converts an electrical input to a mechanical output.	PLTW-POE			
Performance Indicator 2.2.6	Calculate circuit resistance, current, and voltage using Ohm's law.	PLTW-POE			
Benchmark 2.3	Illustrate how energy often needs to be converted from one form to another to meet the needs of a given system.	PLTW-POE	MTH.A.CED.1 MTH.A.CED.4 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.2.a SC.12.2.3.b SC.12.2.3.i	Alignment presumes that students will create and solve equations in order to calculate work and power when illustrating how energy needs to be converted from one form to another (CC: MTH.A.CED.1, MTH.A.CED.4, MTH.A.REI.3; NE: MA.12.2.5.b, MA.12.2.5.d, MA.12.3.2.a).
Performance Indicator 2.3.1	Create and deliver a presentation to explain a specific energy source.	PLTW-POE			
Performance Indicator 2.3.2	Summarize and reflect upon information collected during a visit to a local utility company.	PLTW-POE			
Performance Indicator 2.3.3	Define the possible types of power conversion.	PLTW-POE			
Performance Indicator 2.3.4	Calculate work and power.	PLTW-POE			

Performance Indicator 2.3.5	Calculate power in a system that converts energy from electrical to mechanical.	PLTW-POE			
Benchmark 2.4	Recognize work, energy, and power is required to determine system efficiency.	PLTW-POE	MTH.A.CED.1 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.2.a	Alignment presumes that students will create equations to illustrate how system efficiency is determined (CCSS: MTH.A.CED.1; NE: MA.12.2.5.b, MA.12.2.5.d, MA.12.3.2.a)
Performance Indicator 2.4.1	Summarize and reflect upon information collected during a visit to a local utility company.	PLTW-POE			
Performance Indicator 2.4.2	Define the possible types of power conversion.	PLTW-POE			
Performance Indicator 2.4.3	Calculate work and power.	PLTW-POE			
Performance Indicator 2.4.4	Calculate power in a system that converts energy from electrical to mechanical.	PLTW-POE			
Performance Indicator 2.4.5	Determine efficiency of a system that converts an electrical input to a mechanical output.	PLTW-POE			
Performance Indicator 2.4.6	Calculate circuit resistance, current, and voltage using Ohm's law.	PLTW-POE			
Benchmark 2.5	Apply understanding of three fundamental concepts of voltage, current, and resistance.	PLTW-POE	MTH.A.CED.4 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.2.a MA.12.3.3.f MA.12.3.3.g	

Performance Indicator 2.5.1	Calculate circuit resistance, current, and voltage using Ohm's law.	PLTW-POE			
Performance Indicator 2.5.2	Understand the advantages and disadvantages of parallel and series circuit design in an application.	PLTW-POE			
Benchmark 2.6	Determine whether a material is a conductor, an insulator, or a semiconductor based on atomic structure.	PLTW-POE		SC.12.2.1.f	Alignment presumes that students will calculate circuit resistance, current, and voltage to determine if a material is a conductor, insulator, or semiconductor (NE: MA.12.1.3.a, MA.12.1.3.d, MA.12.2.5.b, MA.12.2.5.d)
Performance Indicator 2.6.1	Calculate circuit resistance, current, and voltage using Ohm's law.	PLTW-POE			
Performance Indicator 2.6.2	Understand the advantages and disadvantages of parallel and series circuit design in an application.	PLTW-POE			
Standard 3 Energy Applications	Students will investigate multiple ways in which energy is used and managed in our world.				

Benchmark 3.1	Explain energy management as the focused on efficient and accessible energy use.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students *explain* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 3.1.1	Identify the different energy systems.	PLTW-POE			
Benchmark 3.2	Analyze system energy requirements to select the proper energy source.	PLTW-POE	MTH.A.CED.4 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.2.a MA.12.3.3.f MA.12.3.3.g	Alignment presumes that students will use Ohm's law while analyzing system energy requirements (CC: MTH.CED.4, MTH.A.REI.3; NE: MA.12.2.5.b, MA.12.2.5.d, MA.12.3.2.a, MA.12.3.3.f, MA.12.3.3.g)
Performance Indicator 3.2.1	Test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell	PLTW-POE			
Benchmark 3.3	Energy systems can include multiple energy sources that can be combined to convert energy into useful forms.	PLTW-POE		SC.12.2.3.b	
Performance Indicator 3.3.1	Test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell	PLTW-POE			

Performance Indicator 3.3.2	Experiment with a solar hydrogen system to produce mechanical power.	PLTW-POE			
Performance Indicator 3.3.3	Convert rotating mechanical energy into electrical energy with a generator.	PLTW-POE			
Benchmark 3.4	Explain how hydrogen fuel cells create electricity and heat through an electrochemical process that converts hydrogen and oxygen into water.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a SC.12.2.1.d SC.12.2.3.e	When students *explain* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 3.4.1	Experiment with a solar hydrogen system to produce mechanical power.	PLTW-POE			
Benchmark 3.5	Illustrate how solar cells convert light energy into electricity by using photons to create electron flow.	PLTW-POE		SC.12.1.1.e SC.12.2.1.f SC.12.2.1.g	
Performance Indicator 3.5.1	Measure electron flow in a solar cell electrical generator.	PLTW-POE			

Benchmark 3.6	Describe thermodynamics as the study of the effects of work, thermo energy, and energy on a system.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4		When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 3.6.1	Create a diagram showing how thermodynamics function in a heating system.	PLTW-POE			
Benchmark 3.7	Identify thermo energy transfer through convection, conduction, or radiation.	PLTW-POE		SC.12.2.3.e	
Performance Indicator 3.7.1	Experiment with different mediums to show and measure heat transfer by convection, conduction, and radiation	PLTW-POE			
Benchmark 3.8	Calculate material conductivity, resistance, and energy transfer.	PLTW-POE	MTH.A.CED.4 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.2.a MA.12.3.3.f MA.12.3.3.g SC.12.2.3.e	
Performance Indicator 3.8.1	Test construction materials for insulation values and heat flow rate.	PLTW-POE			

Standard 4: Energy & Power Design problem	Students will solve energy and power design problems individually and in concert with others through applying energy principles.	PLTW-POE			
Benchmark 4.1	Recognize design problems can be solved by individuals or in teams.	PLTW-POE	ELA.SL.11-12.1	LA.12.3.3	
Performance Indicator 4.1.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 4.1.2	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 4.1.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	PLTW-POE			
Benchmark 4.2	Apply the design process to create solutions to existing problems.	PLTW-POE		SC.12.1.3.a SC.12.1.3.b SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	
Performance Indicator 4.2.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 4.2.2	Create a decision-making matrix for a design problem.	PLTW-POE			

Performance Indicator 4.2.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix	PLTW-POE			
Performance Indicator 4.2.4	Present a workable solution to the design problem.	PLTW-POE			
Benchmark 4.3	Utilize design briefs to identify the problem specifications and to establish project constraints.	PLTW-POE	ELA.RST.11-12.3 ELA.RST.11-12.7	LA.12.1.6.k LA.12.1.6.f SC.12.1.3.e	
Performance Indicator 4.3.1	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 4.3.2	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			
Benchmark 4.4	Observe teamwork requires constant communication to achieve the desired goal.	PLTW-POE	ELA.SL.11-12.1	LA.12.3.3	
Performance Indicator 4.4.1	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			

Performance Indicator 4.4.2	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix	PLTW-POE			
Benchmark 4.5	Conduct research to develop a knowledge base, stimulate creative ideas, and make informed decisions	PLTW-POE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a–c).
Performance Indicator 4.5.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Standard 5: Statics	Students will understand the principles of statics.	PLTW-POE			
Benchmark 5.1	Describe the interaction of forces acting on a body using the Laws of motion.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4 MTH.N.VM.3	LA.12.2.1.b LA.12.3.1.a SC.12.2.2.a SC.12.2.2.d SC.12.2.2.e SC.12.2.2.f	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Benchmark 5.2	Understand structural member properties including centroid location, moment of inertia, and modulus of elasticity are important considerations for structure design.	PLTW-POE	MTH.N.VM.3 MTH.MG.3	MTH.12.2.4.b MTH.12.2.5.a SC.12.2.2.a SC.12.2.2.b SC.12.2.2.c SC.12.2.2.d SC.12.2.2.e	

Performance Indicator 5.2.1	Mathematically locate the centroid of structural members.	PLTW-POE			
Performance Indicator 5.2.2	Calculate moment of inertia of structural members.	PLTW-POE			
Benchmark 5.3	Identify static equilibrium occurs when the sum of all forces acting on a body are equal to zero.	PLTW-POE			
Benchmark 5.4	Recognize applied forces are vector quantities with a defined magnitude, direction, and sense, and can be broken into vector components.	PLTW-POE	MTH.N.VM.1 MTH.N.VM.3		
Performance Indicator 5.4.1	Differentiate between scalar and vector quantities.	PLTW-POE			
Performance Indicator 5.4.2	Identify magnitude, direction, and sense of a vector.	PLTW-POE			
Performance Indicator 5.4.3	Calculate the X and Y components given a vector.	PLTW-POE			
Benchmark 5.5	Describe how forces acting at a distance from an axis or point attempt or cause an object to rotate.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4 MTH.N.VM.1 MTH.N.VM.3	LA.12.2.1.b LA.12.3.1.a SC.12.2.2.a SC.12.2.2.b SC.12.2.2.c SC.12.2.2.d SC.12.2.2.e	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).

Performance Indicator 5.5.1	Calculate moment forces given a specified axis.	PLTW-POE			
Benchmark 5.6	Understand In a statically determinate truss, translational and rotational equilibrium equations can be used to calculate external and internal forces.	PLTW-POE	MTH.A.REI.3 MTH.G.SRT.8 MTH.G.MG.1 MTH.G.MG.3	MA.12.2.4.b MA.12.3.2.a MA.12.3.2.b SC.12.2.2.a SC.12.2.2.b SC.12.2.2.c SC.12.2.2.d SC.12.2.2.e	
Performance Indicator 5.6.1	Use equations of equilibrium to calculate unknown forces.	PLTW-POE			
Performance Indicator 5.6.2	Use the method of joints strategy to determine forces in the members of a statically determinate truss.	PLTW-POE			
Benchmark 5.7	Utilize free body diagrams to illustrate and calculate forces acting upon a given body.	PLTW-POE	MTH.N.VM.1 MTH.N.VM.3	SC.12.2.2.a SC.12.2.2.b SC.12.2.2.c SC.12.2.2.d SC.12.2.2.e	
Performance Indicator 5.7.1	Create free body diagrams of objects, identifying all forces acting on the object.	PLTW-POE			
Standard 6: Material Properties	Students will describe material properties and how materials are selected based such properties.	PLTW-POE			

Benchmark 6.1	Recognize materials are the substances with which all objects are made.	PLTW-POE			
Performance Indicator 6.1.1	Calculate weight, volume, mass, density, and surface area of selected common household product	PLTW-POE			
Benchmark 6.2	Identify elements from which materials are composed and are categorized by physical and chemical properties.	PLTW-POE	ELA.RST.11-12.4	LA.12.1.5 SC.12.2.1.h	
Performance Indicator 6.2.1	Investigate specific material properties related to a common household product.	PLTW-POE			
Benchmark 6.3	Understand materials consist of pure elements and compounds and mixtures are typically classified as metallic, ceramic, organic, polymeric, and composite.	PLTW-POE		SC.12.2.1.h	
Performance Indicator 6.3.1	Conduct investigative non-destructive material property tests on selected common household products. Property testing conducted to identify continuity, ferrous metal, hardness, and flexure.	PLTW-POE			

Benchmark 6.4	Describe the material selection process, including the mechanical, thermal, electromagnetic, and chemical properties basis as well as recyclability and cost considerations.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 6.4.1	Identify the recycling codes.	PLTW-POE			
Performance Indicator 6.4.2	Promote recycling using current media trends.	PLTW-POE			
Benchmark 6.5	Observe the various manufacutring processes raw materials undergo in the production of consumer goods.	PLTW-POE			
Performance Indicator 6.5.1	Investigate specific material properties related to a common household product.	PLTW-POE			
Performance Indicator 6.5.2	Identify the manufacturing processes used to create the selected common household product.	PLTW-POE			
Standard 7: Material Testing	Students will analyze materials through extensive testing.	PLTW-POE			

Benchmark 7.1	Utilize a design process and mathematical formulas to solve and document design problems.	PLTW-POE	MTH.A.CED.1 MTH.A.CED.4 MTH.REI.3	MA.12.3.2.a MA.12.3.2.b SC.12.1.3.a SC.12.1.3.b SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	
Performance Indicator 7.1.1	Utilize a five-step technique to solve word problems.	PLTW-POE			
Performance Indicator 7.1.2	Obtain measurements of material samples.	PLTW-POE			
Benchmark 7.2	Understand how material testing aids in determining a product's reliability, safety, and predictability in function	PLTW-POE			
Performance Indicator 7.2.1	Write a paragraph explaining how material testing helps determine a consumer product's reliability, safety, or predictability	PLTW-POE			
Performance Indicator 7.2.2	Locate a current article or publication of a safety recall and analyze.	PLTW-POE			

Benchmark 7.3	Describe how engineers perform destructive and non-destructive tests on material specimens for the purpose of identifying and verifying the properties of various materials.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 7.3.1	Research ways in which engineers perform tests on material specimens.	PLTW-POE			
Benchmark 7.4	Conduct material testing to provide a reproducible evaluation of material properties.	PLTW-POE	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2 SC.12.1.1.d SC.12.1.1.e	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Performance Indicator 7.4.1	Conduct material testing to provide a reproducible evaluation of material properties.	PLTW-POE			
Benchmark 7.5	Utilize tensile testing data is used to create a test sample stress strain curve.	PLTW-POE			
Performance Indicator 7.5.1	Tensile test a material test sample.	PLTW-POE			

Benchmark 7.6	Employ stress strain data points to identify and calculate sample material properties including elastic range, proportional limit, modulus of elasticity, elastic limit, resilience, yield point, plastic deformation, ultimate strength, failure, and ductility.	PLTW-POE		MA.12.1.3.a MA.12.1.3.d MA.12.3.1.a MA.12.3.1.f SC.12.1.1.f SC.12.1.1.g SC.12.1.1.l	
Performance Indicator 7.6.1	Identify and calculate test sample material properties using a stress strain curve.	PLTW-POE			
Standard 8: Materials & Structures Design Problem	Students will solve materials and structures design problems individually and in concert with others through applying energy principles.	PLTW-POE			
Benchmark 8.1	Recognize design problems can be solved by individuals or in teams.	PLTW-POE			
Performance Indicator 8.1.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 8.1.2	Create a decision-making matrix for a design problem.	PLTW-POE			

Performance Indicator 8.1.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix	PLTW-POE			
Benchmark 8.2	Apply the design process to create solutions to existing problems.	PLTW-POE		SC.12.1.3.a SC.12.1.3.b SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	
Performance Indicator 8.2.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 8.2.2	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 8.2.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix	PLTW-POE			
Performance Indicator 8.2.4	Present a workable solution to the design problem.	PLTW-POE			
Benchmark 8.3	Utilize design briefs to identify the problem specifications and to establish project constraints.	PLTW-POE	ELA.RST.11-12.3 ELA.RST.11-12.7	LA.12.1.6.k LA.12.1.6.f SC.12.1.3.e	

Performance Indicator 8.3.1	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 8.3.2	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			
Benchmark 8.4	Observe teamwork requires constant communication to achieve the desired goal.	PLTW-POE	ELA.SL.11-12.1	ELA.12.3.3	
Performance Indicator 8.4.1	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			
Performance Indicator 8.4.2	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	PLTW-POE			
Benchmark 8.5	Conduct research to develop a knowledge base, stimulate creative ideas, and make informed decisions.	PLTW-POE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a–c).
Performance Indicator 8.5.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			

Standard 9: Machine Control	Students will investigate multiple forms of systems (i.e. control, closed loop, open loop) to control machine function.	PLTW-POE			
Benchmark 9.1	Recognize flowcharts provide a step by step schematic representation of an algorithm or process.	PLTW-POE	ELA.RST.11-12.7	LA.12.1.6.f	
Performance Indicator 9.1.1	Create detailed flow charts utilizing a computer software application.	PLTW-POE			
Benchmark 9.2	Understand control systems are designed to provide consentient process control and reliability.	PLTW-POE			
Performance Indicator 9.2.1	Create control system operating programs utilizing computer software.	PLTW-POE			
Performance Indicator 9.2.2	Create system control programs that utilize flowchart logic.	PLTW-POE			
Benchmark 9.3	Comprehend control system protocols are an established set of commands or functions typically created in a computer programming language.	PLTW-POE			

Performance Indicator 9.3.1	Choose appropriate inputs and output devices based on the need of a technological system.	PLTW-POE			
Benchmark 9.4	Describe how closed loop systems use digital and analog sensor feedback to make operational and process decisions.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 9.4.1	Differentiate between the characteristics of digital and analog devices.	PLTW-POE			
Performance Indicator 9.4.2	Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem	PLTW-POE			
Performance Indicator 9.4.3	Design and create a control system based on given needs and constraints.	PLTW-POE			
Benchmark 9.5	Illustrate how open loop systems use programming constants such as time to make operational and process decisions	PLTW-POE			
Performance Indicator 9.5.1	Differentiate between the characteristics of digital and analog devices.	PLTW-POE			

Performance Indicator 9.5.2	Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem	PLTW-POE			
Performance Indicator 9.5.3	Design and create a control system based on given needs and constraints.	PLTW-POE			
Standard 10: Fluid Power	Students will understand the principles of fluid power.	PLTW-POE			
Benchmark 10.1	Understand fluid power systems are categorized as either pneumatic, which utilizes gas, or hydraulic, which utilizes liquid	PLTW-POE			
Performance Indicator 10.1.1	Identify devices that utilize fluid power.	PLTW-POE			
Performance Indicator 10.1.2	Differentiate between the characteristics of pneumatic and hydraulic systems.	PLTW-POE			
Benchmark 10.2	Recognize fluid power is possible because in a system of confined fluid, pressure acts equally in all directions.	PLTW-POE		MA.12.1.3.a MA.12.1.3.d MA.12.2.5.b MA.12.2.5.d MA.12.3.1.f SC.12.2.2.a SC.12.2.2.c SC.12.2.2.e	Alignment presumes that students will calculate fluid power using appropriate methods of computation, apply and convert units of measurement, and determine the rate of change in fluid pressure (NE: MA.12.1.3.a, MA.12.1.3.b, MA.12.2.5.b, MA.12.2.5.d, MA.12.3.1.f).

Performance Indicator 10.2.1	Calculate values in a fluid power system utilizing Pascal's Law.	PLTW-POE			
Benchmark 10.3	Identify the most basic components of all fluid power systems include a reservoir or receiver, a pump or compressor, a valve, and a cylinder.	PLTW-POE	ELA.RST.11-12.4	LA.12.1.5	
Performance Indicator 10.3.1	Identify and explain basic components and functions of fluid power devices.	PLTW-POE			
Benchmark 10.4	Comprehend fluid power systems are designed to transmit force over great distances, multiply an input force, and increase the distance that an output will move.	PLTW-POE	MTH.A.CED.1	MA.12.2.5.b MA.12.3.2.a MA.12.3.1.f SC.12.1.3.b SC.12.2.2.a SC.12.2.2.c SC 12.2.2.e	
Performance Indicator 10.4.1	Design, create, and test a hydraulic device.	PLTW-POE			
Performance Indicator 10.4.2	Design, create, and test a pneumatic device.	PLTW-POE			
Performance Indicator 10.4.3	Calculate values in a fluid power system utilizing Pascal's Law.	PLTW-POE			
Performance Indicator 10.4.4	Calculate values in a pneumatic system, utilizing the perfect gas laws.	PLTW-POE			
Performance Indicator 10.4.5	Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.	PLTW-POE			

Benchmark 10.5	Describe the laws about the behavior of fluid systems and standard conventions for calculating values within fluid systems aid in the design and understanding of such systems.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4 MTH.A.SSE.1 MTH.A.REI.3	LA.12.2.1.b LA.12.3.1.a MA.12.2.5.b MA.12.2.5.d MA.12.3.1.f	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 10.5.1	Calculate values in a fluid power system utilizing Pascal's Law.	PLTW-POE			
Performance Indicator 10.5.2	Calculate values in a pneumatic system, utilizing the perfect gas laws.	PLTW-POE			
Performance Indicator 10.5.3	Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.	PLTW-POE			
Benchmark 10.6	Utilize standard schematic symbols and conventions are used to communicate fluid power designs.	PLTW-POE			
Performance Indicator 10.6.1	Identify and explain basic components and functions of fluid power devices.	PLTW-POE			
Standard 11: Control Systems Design Problem					
Benchmark 11.1	Recognize design problems can be solved by individuals or in teams.	PLTW-POE	ELA.SL.11-12.1	LA.12.3.3	

Performance Indicator 11.1.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 11.1.2	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 11.1.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	PLTW-POE			
Benchmark 11.2	Apply the design process to create solutions to existing problems.	PLTW-POE		SC.12.1.3.a SC.12.1.3.b SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	
Performance Indicator 11.2.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 11.2.2	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 11.2.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix	PLTW-POE			
Performance Indicator 11.2.4	Present a workable solution to the design problem.	PLTW-POE			

Benchmark 11.3	Utilize design briefs to identify the problem specifications and to establish project constraints.	PLTW-POE	ELA.RST.11-12.3 ELA.RST.11-12.7	LA.12.1.6.f LA.12.1.6.k SC.12.1.3.e	
Performance Indicator 11.3.1	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 11.3.2	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			
Benchmark 11.4	Observe teamwork requires constant communication to achieve the desired goal.	PLTW-POE	ELA.SL.11-12.1	LA.12.3.3	
Performance Indicator 11.4.1	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			
Performance Indicator 11.4.2	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	PLTW-POE			
Benchmark 11.5	Conduct research to develop a knowledge base, stimulate creative ideas, and make informed decisions.	PLTW-POE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a–c).

Performance Indicator 11.5.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Standard 12	Students will utilize statistics to analyze data associated with engineering problems.	PLTW-POE			
Benchmark 12.1	Use statistics to make informed decisions based upon established principles.	PLTW-POE	MTH.S.CP.5 MTH.S.CP.9 MTH.S.MD.5 MTH.S.MD.6 MTH.S.MD.7	MA.12.4.3.b MA.12.4.3.c MA.12.4.3.e	
Performance Indicator 12.1.1	Calculate the theoretical probability that an event will occur.	PLTW-POE			
Performance Indicator 12.1.2	Calculate the experimental frequency distribution of an event occurring.	PLTW-POE			
Benchmark 12.2	Understand visual representations of data analyses allow for easy distribution and understanding of data.	PLTW-POE	ELA.RST.11-12.7 MTH.S.CP.4 MTH.S.CP.5	LA.12.1.6.f MA.12.4.3.b MA.12.4.3.c	
Performance Indicator 12.2.1	Apply the Bernoulli process to events that only have two distinct possible outcomes.	PLTW-POE			
Performance Indicator 12.2.2	Apply AND, OR, and NOT logic to probability.	PLTW-POE			

Performance Indicator 12.2.3	Create a histogram to illustrate frequency distribution.	PLTW-POE			
Benchmark 12.3	Recognize statistics is based upon both theoretical and experimental data analysis.	PLTW-POE	MTH.S.IC.2	MA.12.4.1.e	
Performance Indicator 12.3.1	Calculate the central tendency of a data array, including mean, median, and mode.	PLTW-POE			
Performance Indicator 12.3.2	Calculate data variation, including range, standard deviation, and variance.	PLTW-POE			
Standard 13	Students will investigate the motion of bodies (kinematics).	PLTW-POE			
Benchmark 13.1 -	Understand when working with bodies in motion, engineers must be able to differentiate and calculate distance, displacement, speed, velocity, and acceleration.	PLTW-POE	MTH.N.VM.3 MTH.A.SSE.1 MTH.A.CED.1 MTH.A.CED.4 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.1.a MA.12.3.2.a MA.12.3.2.b MA.12.3.2.c SC.12.1.1.l SC.12.2.2.a SC.12.2.2.b	
Performance Indicator 13.1.1	Calculate distance, displacement, speed, velocity, and acceleration from data.	PLTW-POE			

Benchmark 13.2	Describe what happens when air resistance is not taken into account, released objects will experience acceleration due to gravity, also known as freefall.	PLTW-POE	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a SC.12.2.f	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Performance Indicator 13.2.1	Calculate distance, displacement, speed, velocity, and acceleration from data.	PLTW-POE			
Performance Indicator 13.2.2	Calculate acceleration due to gravity given data from a free fall device.	PLTW-POE			
Benchmark 13.3 -	Projectile motion can be predicted and controlled using kinematics equations.	PLTW-POE	MTH.N.VM.3 MTH.A.SSE.1 MTH.A.CED.1 MTH.A.CED.4 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.1.a MA.12.3.2.a MA.12.3.2.b MA.12.3.2.c SC.12.1.1.l SC.12.2.2.a SC.12.2.2.b	
Performance Indicator 13.3.1	Calculate distance, displacement, speed, velocity, and acceleration from data.	PLTW-POE			
Performance Indicator 13.3.2	Design, build, and test a vehicle that stores and releases potential energy for propulsion.	PLTW-POE			

Benchmark 13.4 -	When a projectile is launched, velocity in the x direction remains constant; whereas, with time, the velocity in the Y direction in magnitude and direction changes due to gravity.	PLTW-POE	MTH.N.VM.3 MTH.A.SSE.1 MTH.A.CED.1 MTH.A.CED.4 MTH.A.REI.3	MA.12.2.5.b MA.12.2.5.d MA.12.3.1.a MA.12.3.2.a MA.12.3.2.b MA.12.3.2.c SC.12.1.1.l SC.12.2.2.a SC.12.2.2.b	
Performance Indicator 13.4.1	Calculate distance, displacement, speed, velocity, and acceleration from data.	PLTW-POE			
Performance Indicator 13.4.2	Calculate the X and Y components of a projectile motion.	PLTW-POE			
Performance Indicator 13.4.3	Determine the angle needed to launch a projectile a specific range given the projectile's initial velocity	PLTW-POE			
Standard 14: Statistics and Kinematics Design Problem					
Benchmark 14.1	Recognize design problems can be solved by individuals or in teams.	PLTW-POE	ELA.SL.11-12.1	LA.12.3.3	

Performance Indicator 14.1.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 14.1.2	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 14.1.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	PLTW-POE			
Benchmark 14.2	Apply the design process to create solutions to existing problems.	PLTW-POE		SC.12.1.3.a SC.12.1.3.b SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	
Performance Indicator 14.2.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			
Performance Indicator 14.2.2	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 14.2.3	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.	PLTW-POE			
Performance Indicator 14.2.4	Present a workable solution to the design problem.	PLTW-POE			

Benchmark 14.3	Utilize design briefs to identify the problem specifications and to establish project constraints	PLTW-POE	ELA.RST.11-12.3 ELA.RST.11-12.7	LA.12.1.6.f LA.12.1.6.k SC.12.1.3.e	
Performance Indicator 14.3.1	Create a decision-making matrix for a design problem.	PLTW-POE			
Performance Indicator 14.3.2	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			
Benchmark 14.4	Observe teamwork requires constant communication to achieve the desired goal.	PLTW-POE	ELA.SL.11-12.1	LA.12.3.3	
Performance Indicator 14.4.1	Select an approach that meets or satisfies the constraints provided in a design brief.	PLTW-POE			
Performance Indicator 14.4.2	Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix	PLTW-POE			
Benchmark 14.5	Conduct research to develop a knowledge base, stimulate creative ideas, and make informed decisions	PLTW-POE	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a–c).

Performance Indicator 14.5.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-POE			